longitudinally of the hollow fibers,

wherein the respective elements comprise i) a feed tube disposed longitudinally of the hollow fibers and ii) a hollow fiber bundle covering the outer surface of the feed tube, the feed tube having a number of holes therein, and the hollow fibers having one end closed and the other end opened,

wherein the feed tubes of the two elements have one end opened and the other end closed,

wherein the container comprises i) an inner wall surrounding the two elements with a space and two end walls, ii) a feed port provided at one end of the container in communication with the opened end of the feed tube of one of the elements, iii) an inner liquid receiving plate located between the two elements to collect the liquid not permeated through said one elements, iv) a connecting tube for connecting the inner liquid receiving plate with the open end of the feed tube of the other element, v) a permeate-liquid outlet facing the open end of the hollow fibers of each element and extending through the end wall of the container adjacent to the open end of the hollow fiber bundle of each element, and vi) a non-permeated fluid discharge outlet located as opposed to the outer surface of the other element and extending through the container wall in communication with the space and the outside of the container wall, and

further wherein the centerline of the discharge outlet of the container being substantially proximal to one end of the container whereby any space downstream of said outlet is sufficiently small to allow purging of suspended materials, thereby minimizing pressure loss in the permselective membrane module.

REMARKS

Claims 1-2 and 5-6 are currently pending in the present application. The Applicants have carefully reviewed the March 6, 2002 Office Action, and respectfully submit the foregoing amendments and following remarks in response thereto.

The drawings stand objected to for failing to show the permeate outlet extending through the end wall of the container. For the reasons discussed below, the Applicants respectfully submit that this feature is adequately disclosed and described in the present application, and therefore no drawing changes are required.

Claims 5-6 stand rejected under 35 U.S.C. § 112, second paragraph as indefinite due to a question as to whether the claimed container and vessel are the same elements. The claims have been amended to clarify that these terms do refer to the same element; these amendments are not intended to alter or otherwise surrender any scope of claim coverage. In addition, similar claim language in claims 1-2 has been amended solely for clarity. Withdrawal of this rejection is respectfully requested.

Claims 1-2 and 5-6 stand rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent No. 4,293,419 to Sekino, *et al.* ("Sekino") in view of U.S. Patent No. 5,380,433 to Etienne, *et al.* ("Etienne"), U.S. Patent No. 5,160,042 to Bikson, *et al.* ("Bikson") and an article, *Synthetic Membranes and Membrane Separation Processes* by Matsuura ("Matsuura"). For the reasons set forth below, the Applicants respectfully maintain that these claims are patentable in their present form over the cited references.

In view of the foregoing amendments and the following remarks, the Applicants respectfully request the pending objection and rejections be withdrawn and claims 1-2 and 5-6 be allowed.

1. <u>The Drawing Objection Should Be Withdrawn</u>.

The Applicants respectfully traverse the objection to the drawings on the grounds that the feature at issue, the permeate outlet extending through the end wall of the container, is adequately described and illustrated of the present application.

The specification of the present application expressly describes the permeate flow path out the end plates, as illustrated in Fig. 1. The specification first identifies that the permeate flows through end plates 7 and 7'. These end plates are identified as "tube sheets," a term that one of ordinary skill in the art would readily recognize as indicating plates with numerous through holes. The specification next states that the permeate passing through the tube sheets is collected by support plates 9, 9' and is then moved through outlets 11, 11' and out the end plates. Application at 10:6-11 ("After passing [through the hollow fiber layers], the permeate purified water flows out of the hollow fibers through the tube sheets 7, 7'. Then, the purified water is collected by support plates 9, 9' and discharged from the pressure vessel via fluid outlets 11, 11'.").

In view of the express description in the specification, the Applicants respectfully

submit that the specification and drawings in their current form adequately describe and illustrate a "permeate outlet extending through the end wall of the container," including both the outlets 11, 11', and the flow path by which permeate reaches the outlets. The Applicants therefore respectfully request the pending drawing objection be reconsidered and withdrawn.

2. <u>The Claims Are Patentable Under § 103(a) Over The Cited References</u>.

The Applicants respectfully traverse the rejection of claims 1-2 and 5-6 as unpatentable under § 103(a) over Sekino, Etienne, Bikson and Matsuura on the grounds that these references do not teach or suggest all the features of the present invention.

The present invention is directed to a permselective membrane module with two longitudinal hollow fiber bundles, a feed tube within the bundles through which feed water enters through the end of the module, permeate outlets at the ends of the module, and a non-permeate outlet through the container wall located "substantially proximal to one end of the container" such that "any space downstream of said outlet *is sufficiently small to allow purging of suspended materials*, thereby minimizing pressure loss in the permselective membrane module." This language reflects the Applicants' discovery -- not suggested in the prior art -- that placement of the non-permeate outlet *in the outer wall* of the module container in a location *sufficiently close to the end of the module* would provide the highly desirable results of minimal pressure drop up to and through the outlet, coupled with efficient purging of suspended materials to prevent build up of such materials within the module to the point of decreasing non-permeate flow and increasing pressure losses.

The Applicants respectfully submit that the present novel permselective membrane module configuration has not been previously taught or suggested, notwithstanding the Examiner's combination of four separate references in attempting assemble the present invention from the prior art.

The first cited reference, Sekino, is cited as disclosing the "double bundle hollow fiber membranes" and claim 1's feed tube, connecting tube, container wall and ends, and permeate discharge. March 6, 2002 Office Action at 4. The Office Action acknowledges that Sekino does not disclose the feed provided through an end of the container, nor the non-permeate discharge proximal to the end of the container, but then asserts that the discharge of concentrate (non-permeate) is "at the end of one of the modules, where the major solids

accumulation is expected." *Id.* The Office Action then repeats that Sekino does not disclose feeding the module or positioning the feed entrance to the feed tube at the end walls of the housing. *Id.*

Review of Sekino reveals that this reference teaches an apparatus that in virtually every measure is the polar opposite of the present invention; indeed, the only elements in common appear to be the use of a housing and the positioning of two fiber bundles. Unlike the present invention, Sekino has its feed and non-permeate ports in the center of the container, with right angle turns into and out of the opposing chambers. This configuration creates a high pressure-drop fluid path wherein the fluid must enter one fiber bundle chamber through a right-angle central port, pass through the first fiber bundle, enter the central tube connecting the two fiber bundles to pass to the second fiber bundle chamber, pass through the second fiber bundle, then finally be forced out a second right-angle central port. *See, e.g.,* Sekino Fig. 1. Such a high-flow resistance, series flow design does not begin to teach or suggest the present invention's low-resistance shared-feed, parallel-flow dual fiber bundle arrangement, with its high-flow end-plate inlet and side wall outlet. *See* Application Fig. 1.

Moreover, contrary to the assertion in the Office Action, Sekino does not disclose or suggest the present invention's location of the non-permeate outlet in the container wall "substantially proximal to one end of the container whereby any space downstream of said outlet is sufficiently small to allow purging of suspended materials." As shown in Sekino Fig. 1, the non-permeate outlet leaves the fiber bundle chamber at the *end* of the chamber, though the center dividing plate. The only relationship this end-located outlet has to the container wall is that after entering the center dividing plate, the outlet port makes a right-angle turn to exit the container through its side wall. *Id.* Thus, Sekino does not teach or suggest the present invention's location of the non-permeate outlet in the container side wall, let alone its location "substantially proximal to one end of the container whereby any space downstream of said outlet is sufficiently small to allow purging of suspended materials."

The second reference, Bikson, is cited as disclosing the inlet to the central feed tube at the end walls of the housing, and the positioning of the non-permeate (retentate) outlet "at any position of the container wall." March 6, 2002 Office Action at 4. The Office Action then asserts that it would have been obvious to arrange the Sekino apparatus with the Bikson feed inlet and non-permeate outlet arrangements. The Applicants respectfully submit that

nothing in either Sekino nor Bikson would have taught or suggested their combination to one of ordinary skill in the art, and that the attempt to combine these references at this late date is an impermissible use of hind-sight knowledge of the present invention's novel features.

Bikson is a single stage (single fiber bundle) apparatus in which feed enters one end of the container and non-permeate exits through a central side outlet. Bikson Fig. 5. Sekino, on the other hand, is a double-bundle unit with a complicated flow path which forces feed to enter the side of the container, pass sequentially through both fiber bundles, and then exit back out the side of the container at its center. There is nothing in either of these references which suggests the combination of Bikson's single-stage, end-fed arrangements with Sekino's double-bundle, sequential flow apparatus would result in the present inventions' parallel fiber bundle flow, low-pressure-drop module. Indeed, there in nothing in either Bikson or Sekino that even suggests that it would be possible to adapt Bikson to Sekino to obtain the present invention, as incorporation of Bikson's end feed inlet would *at best* require fundamental alteration of the flow paths within the Sekino device and significant changes to its internal structure. Even then, the combination would not result in an arrangement in which the non-permeate flow effectively "flushed" solid materials, as the central non-permeate outlet taught in both Sekino and Bikson would still leave large, unswept areas at the outer ends of the Sekino apparatus where solids could accumulate and reduce non-permeate flow out of the fiber bundles.[1]

Finally, the Examiner cites the next reference, Etienne, as teaching an end feed inlet and end residue or retentate (non-permeate) outlet, and asserts that it would have been obvious to combine this feature with the side non-permeate outlets shown in the Matsuura article or Bikson to "remove solids accumulated at the [end] of the housing, since the outlet

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[1] In the March 6, 2002 Office Action, the Examiner repeats a prior assertion that Bikson teaches that the non-permeate outlet can be located *anywhere* along the length of the container sidewall. As the Applicants noted in their December 11, 2001 Response at page 5, Bikson does nothing more than confirm that its central side port need not be located *precisely* centered in the side of the container, and does so while in the same section noting that the movement of the port is *limited* by having sufficient annular space between the bundles and the container, and that it is preferable that the port remain *"essentially* at the center." December 11, 2001 Response at 5. The Applicants continue to maintain that Bikson does not suggest placement of the non-permeate port in the side of the container substantially proximal to the container end, as in the present invention.

[of Etienne] is in communication with the area near the end of the housing." March 6, 2002 Office Action at 4-5. The Applicants respectfully maintain that these references, either alone or in combination, do not teach or suggest the present invention's solid materials accumulation avoidance.

As a threshold matter, the Applicants submit that one of ordinary skill in the art would not have looked to Etienne in the first place, as this reference teaches a non-permeate outlet dead center in the end cap of the housing -- a location that one of ordinary skill would immediately recognize as inherently permitting the accumulation of pressure-loss increasing solids deposits in the low-flow areas *around the entire periphery of the housing end cap.* This configuration would have been an obviously poor choice for someone seeking to create a module which maintains flow in a manner that minimizes solid materials build-up-related pressure losses, and thus would not have provided any suggestion of its use to one of ordinary skill attempting to address the problems solved by the present invention.

As to the proposed combination of Etienne and Matsuura, the Applicants note that the housing disclosed in Matsuura shows a side outlet 4 located sufficiently far away from the end of the container that, unlike the present invention, solid materials could easily accumulate at the end portion of the container and thereby increase pressure loss within the device. The Applicants respectfully submit that because Matsuura teaches a side outlet that would permit solid materials accumulation in the container end, and Etienne similarly teaches a design that would permit solids to accumulate around the container end, there would have been no motivation to combine these two references to obtain the present invention's solid materials accumulation-avoiding design. Moreover, nothing in either Etienne or Matsuura begins to suggest such a combination, *i.e.*, there is no suggestion in either reference that movement of their respective non-permeate outlets to the side of the container at a location "substantially proximal to one end of the container whereby any space downstream of said outlet is sufficiently small to allow purging of suspended materials" would result in the pressure loss reduction benefits discovered by the Applicants.

For the foregoing reasons, the Applicants submit that one of ordinary skill in the art would not have discerned any suggestion in the cited references to combine all four of these references to obtain the present invention, nor would there have been any motivation to do so. Further, because these four references, either alone or in combination, do not teach or suggest

all the features of the present invention as recited in pending claims 1-2 and 5-6, the Applicants respectfully request the § 103(a) rejection of claims 1-2 and 5-6 be reconsidered and withdrawn.

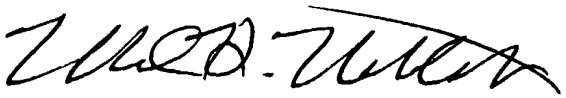
Conclusion

In view of the foregoing amendments and remarks, it is respectfully submitted that all of the presently pending claims are allowable. The Applicants therefore earnestly solicit an early and favorable action on the merits and issuance of a Notice of Allowance for claims 1-2 and 5-6.

The Examiner is invited to contact the undersigned at (202) 220-4232 discuss any matter concerning this application.

The Office is authorized to charge any underpayment or credit any overpayment to Kenyon & Kenyon Deposit Account No. 11-0600.

Respectfully submitted,
KENYON & KENYON



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MARKED-UP VERSION OF AMENDMENTS

IN THE CLAIMS:

1. (Fourth amendment) A permselective membrane module comprising i) two permselective membrane elements formed of hollow fibers arranged substantially in parallel and bundled together and ii) a container, the two elements being arranged in the container longitudinally of the hollow fibers,

wherein the respective elements comprise i) a feed tube disposed longitudinally of the hollow fibers and ii) a hollow fiber bundle covering the outer surface of the feed tube, the feed tube having a number of holes therein, and the hollow fibers having one end closed and the other end opened,

wherein the feed tubes of the two elements communicate with each other via a connecting tube to form a conduit having one end opened and the other end closed,

wherein the container comprises i) an inner wall surrounding the two elements with a space, ii) a feed port provided at one end of the container in communication with the opened end of the conduit, iii) a permeate-liquid outlet facing the open end of the hollow fiber bundle of each element and extending through the container wall, and iv) a non-permeated fluid discharge outlet located as opposed to the outer surface of each element and extending through the container wall in communication with a gap and the outside of the container wall, and

further wherein [the container comprises a cylindrical pressure vessel,] the centerline of the discharge outlet of the container being substantially proximal to one end of the container [cylindrical pressure vessel] whereby any space downstream of said outlet is sufficiently small to allow purging of suspended materials, thereby minimizing pressure loss in the permselective membrane module.

2. (Fourth amendment) A permselective membrane module comprising i) two permselective membrane elements formed of hollow fibers arranged substantially in parallel and bundled together and ii) a container, the two elements being arranged in the container longitudinally of the hollow fibers,

wherein the respective elements comprise i) a feed tube disposed longitudinally of the

hollow fibers and ii) a hollow fiber bundle covering the outer surface of the feed tube, the feed tube having a number of holes therein, and the hollow fibers having one end closed and the other end opened,

wherein the feed tubes of the two elements have one end opened and the other end closed,

wherein the container comprises i) an inner wall surrounding the two elements with a space, ii) a feed port provided at one end of the container in communication with the opened end of the feed tube of one of the elements, iii) an inner liquid receiving plate located between the two elements to collect the liquid not permeated through said one elements, iv) a connecting tube for connecting the inner liquid receiving plate with the open end of the feed tube of the other element, v) a permeate-liquid outlet facing the open end of the hollow fibers of each element and extending through the container wall, and vi) a non-permeated fluid discharge outlet located as opposed to the outer surface of the other element and extending through the container wall in communication with the space and the outside of the container wall, and

further wherein [the container comprises a cylindrical pressure vessel,] the centerline of the discharge outlet <u>of the container</u> being substantially proximal to one end of the <u>container</u> [cylindrical pressure vessel] whereby any space downstream of said outlet is sufficiently small to allow purging of suspended materials, thereby minimizing pressure loss in the permselective membrane module.

5. (Once amended) A permselective membrane module comprising i) two permselective membrane elements formed of hollow fibers arranged substantially in parallel and bundled together and ii) a container, the two elements being arranged in the container longitudinally of the hollow fibers,

wherein the respective elements comprise i) a feed tube disposed longitudinally of the hollow fibers and ii) a hollow fiber bundle covering the outer surface of the feed tube, the feed tube having a number of holes therein, and the hollow fibers having one end closed and the other end opened,

wherein the feed tubes of the two elements communicate with each other via a connecting tube to form a conduit having one end opened and the other end closed,

wherein the container comprises i) an inner wall surrounding the two elements with a space and two end walls, ii) feed port provided at one end of the container in communication with the opened end of the conduit, iii) a permeate-liquid outlet facing the open end of the hollow fiber bundle of each element and extending through the end wall of the container adjacent to the open end of the hollow fiber bundle of each element, and iv) a non-permeated fluid discharge outlet located as opposed to the outer surface of each element and extending through the container wall in communication with a gap and the outside of the container wall, and

further wherein [the container comprises a cylindrical pressure vessel,] the centerline of the discharge outlet of the container being substantially proximal to one end of the container [cylindrical pressure vessel] whereby any space downstream of said outlet is sufficiently small to allow purging of suspended materials, thereby minimizing pressure loss in the permselective membrane module.

6. (Once amended) A permselective membrane module comprising i) two permselective membrane elements formed of hollow fibers arranged substantially in parallel and bundled together and ii) a container, the two elements being arranged in the container longitudinally of the hollow fibers,

wherein the respective elements comprise i) a feed tube disposed longitudinally of the hollow fibers and ii) a hollow fiber bundle covering the outer surface of the feed tube, the feed tube having a number of holes therein, and the hollow fibers having one end closed and the other end opened,

wherein the feed tubes of the two elements have one end opened and the other end closed,

wherein the container comprises i) an inner wall surrounding the two elements with a space and two end walls, ii) a feed port provided at one end of the container in communication with the opened end of the feed tube of one of the elements, iii) an inner liquid receiving plate located between the two elements to collect the liquid not permeated through said one elements, iv) a connecting tube for connecting the inner liquid receiving plate with the open end of the feed tube of the other element, v) a permeate-liquid outlet

facing the open end of the hollow fibers of each element and extending through the end wall of the container adjacent to the open end of the hollow fiber bundle of each element, and vi) a non-permeated fluid discharge outlet located as opposed to the outer surface of the other element and extending through the container wall in communication with the space and the outside of the container wall, and

further wherein [the container comprises a cylindrical pressure vessel,] the centerline of the discharge outlet <u>of the container</u> being substantially proximal to one end of the <u>container</u> [cylindrical pressure vessel] whereby any space downstream of said outlet is sufficiently small to allow purging of suspended materials, thereby minimizing pressure loss in the permselective membrane module.